Paper ID: 31769
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SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (9)

Author: Mr. yuanguang wang
Beijing Electro-Mechanical Engineering Institute, China Aerospace Science & Industry Corporation (CASIC), China

DEVELOPMENT OF AN INTEGRATED PLATFORM FOR SCRAMJET ENGINE OPTIMIZATION DESIGN

Abstract

Scramjet will be one of the most promising propulsion engines in the near future. However, the design of scramjet configuration and selection of working state still remain a tough problem. As it is known to all, a scramjet engine has three components, namely, inlet, combustion chamber and nozzle. The truth that the performance of each component is closely related with that of another component makes it important for us to climb to greater heights to view the optimization process of the whole engine. Therefore, the design of major scramjet parameters must be based upon the large-scale performance calculations of the entire three components. Actually the calculations will consume lots of time, especially in the early stage of design. It is presented in this paper the construction and implementation of a design and optimization platform software, which enables the calculation and optimization to be carried out smoothly and streamlines the methodology of scramjet design. Established through the use of Python, the platform software includes three levels of scramjet performance estimation models. Namely, the models are impulse analysis method, generalized 1-D unsteady Euler equation and 2-D N-S equation disposed by source-addition method. In terms of calculation precision and the consumption of time, these three models can be used in different design stages. Based on the models, there are two stages of optimization in the platform. The first stage aims to improve the local flow status of each individual component; the second stage aims to increase the performance of the entire engine. Because of its quick response ability, the software provides a good platform on which a large-scale optimization of design parameters of scramjet engine can be carried out. A detailed example will be presented in the paper, showing that the platform assigns each design parameter of a component to its appropriate location in the first or second optimization stage automatically and reduces remarkably the level of optimization consumption time as a whole. Calculation results show that a gradually increasing the expansion angle of the combustion chamber will tend to increase the specific impulse of the engine. The platform builds a bridge to link the every design parameter of a single component and whole performance of the scramjet engine based upon the different levels of estimation models and optimization methods. The research will include more performance calculation methods at different levels to the platform to facilitate the optimization process.